CHAPTER 1

A FEASIBILITY STUDY FOR A VOUCHER MANAGEMENT SYSTEM (VOMS) AS PART OF INTELLIGENT NETWORKS (IN) ARCHITECTURE FOR TELECOMMUNICATIONS OPERATORS IN A CHANGING CUSTOMER SERVICE MARKET: INTRODUCTION TO THE STUDY

1.1 INTRODUCTION

This research project was undertaken to establish whether it would be possible to increase the application service availability of an existing voucher management system (VOMS), and if it would be economically feasible to do so.

The rationale behind the improvement required for an existing architecture was driven by a changing consumer market. VOMS formed part of a PrePaid system, which is a component of an intelligent network (IN) or service control point (SCP) network.

The title of this research report, *A Feasibility Study for a Voucher Management System (VOMS) as Part of Intelligent Networks (IN) Architecture for Telecommunications Operators in a Changing Customer Service Market*, provides the context within which a VOMS system is operated and its role within an IN environment of a telecommunications system. Application service availability was the focus of the study; methods to improve the overall service availability were explored and the viability of such an implementation was investigated.

According to Holubecs *et al.* [3], a Voucher Management System (VOMS) assists mobile operators to provide an improved method of service delivery to an existing subscriber market. VOMS could be designed to be a standalone system that operates independently within a mobile network. This offering was targeted at a specific segment of the market. This VOMS system would form part of the collective PrePaid service offering [3].

As described by Anderson [4], Bellcore had made claim to the term Intelligent Network (IN) as far back as the 1980s. IN had provided a method that allowed an ease of new telecommunication services onto an existing network, of which those services could be

modified. As with all core technologies, IN was no different, as it too would be based on a central architecture. It was important to note that the service control layer was separate from the call control layer. The International Telecommunications Union additionally defined an IN conceptual model (INCM) which was a methodology to design and describe the Intelligent Networks Architecture [4].

The primary function of VOMS was to generate voucher Personal Identification Numbers (PINS) [5]. Each of these PIN numbers was worth a certain monetary amount, and this association was kept on VOMS. When a transactional request was processed on VOMS, the voucher would be provided and a redemption request would be put forward. The value of the provided voucher would then be found on the database and that specified amount be added to the subscriber's IN account.

An analysis was done to assess whether this project could be successfully undertaken. To determine if this project would be worth spending time and money on, a feasibility study was carried out to determine those positive and negative determining factors.

1.2 BACKGROUND TO THE PROBLEM ADDRESSED IN THE STUDY

The VOMS idea began when subscribers had a need to add money to their mobile PrePaid accounts without having to use a service provider to load their accounts manually. Subscribers prior to a VOMS system had to walk into a service provider shop and purchase airtime. This airtime was then loaded onto their account at the shop. The initial layout for the above-mentioned system is depicted in Figure 1.1.

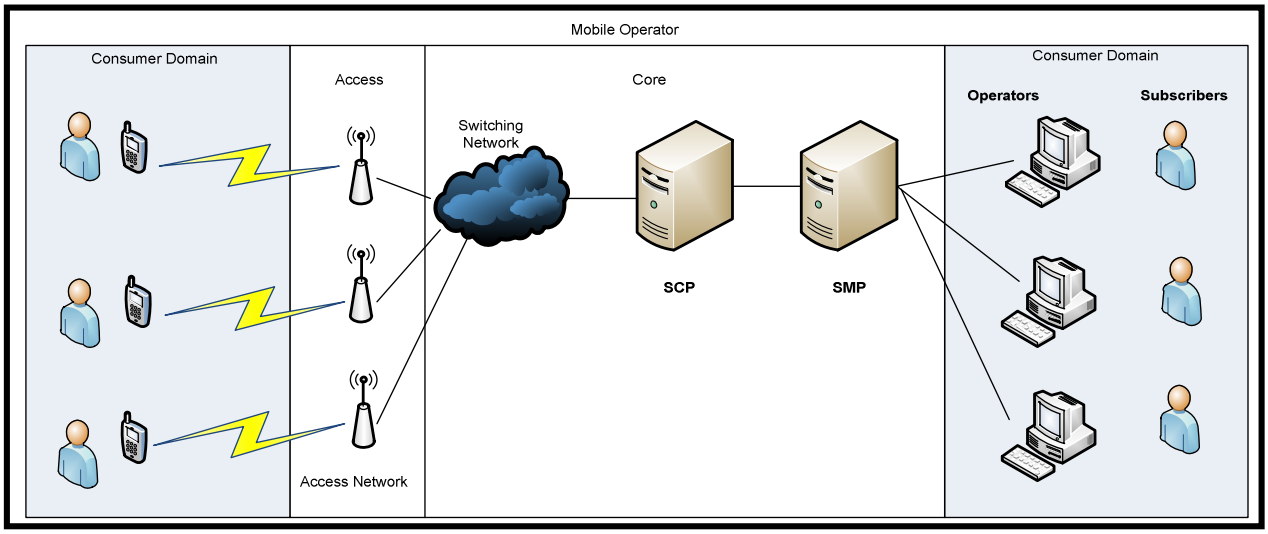

FIGURE 1.1: First proposed PrePaid offering [6]

The service providers had a connection to the Service Management Point (SMP) and loaded money via an SMP to the Service Control Point (SCP), or more commonly known as an Intelligent Network (IN) platform.

The drawback of this approach was that subscribers were restricted to a service provider's business hours to load money, or rather airtime, onto their accounts. This resulted in them being bound by time and place when they ran out of airtime. Subscribers wanted to be able to load money on their PrePaid accounts at any time, any place and anywhere in the country.

According to Gathercole [6], a comparative solution that was used in the United States at that time was a VOMS that would behave as both an IN and a VOMS. When the calling party A would set up a call to party B, the call was routed by the switching network to the VOMS system. The VOMS system would then initiate the call to the B party. The call would then be monitored by the VOMS system. This call set-up was referred to as tromboning, as represented in Figure 1.2. Tromboning refers to how a call would start at a certain point within a network and would be directed out into a mobile operator's switching network and then return back to where it originated from. This was similar to the "shape" of a trombone. How recharges were processed with regard to the tromboning setup is depicted in Figure 1.2; the PrePaid server only comprised a VOMS. Recharges were done in the same way as depicted in Figure 1.1. The main difference between tromboning and the setup in Figure 1.1 was that the calls were routed through this VOMS [6].

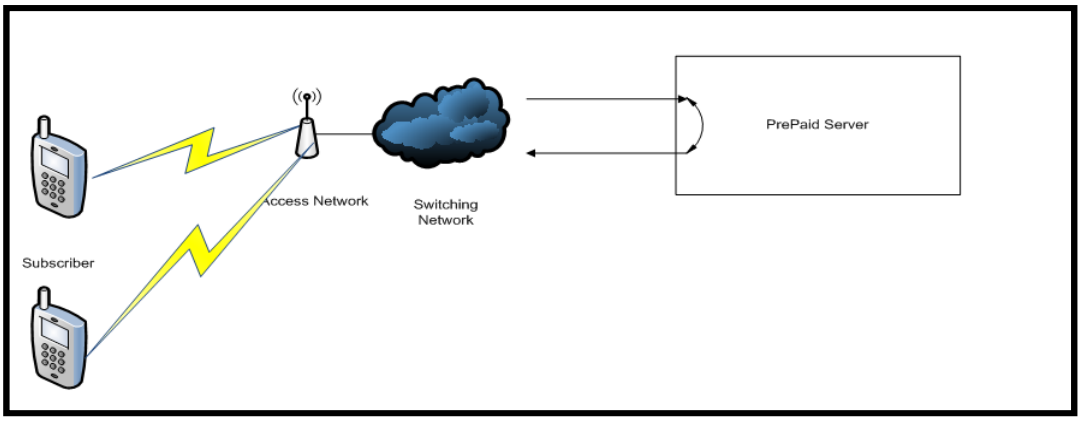

FIGURE 1.2: The tromboning effect [6]

While the tromboning method worked, the main concern was that all the call traffic had to be routed via the VOMS. While call volumes remained low, this solution worked; however, although this service grew, the solution was not scalable in a growing market.

Although the tromboning method satisfied the demand temporarily, it became clear that another solution was required to provide for the fast growing market. Figure 1.3 depicts an accepted method by a mobile operator for a PrePaid offering that was an improvement much welcomed by customers.

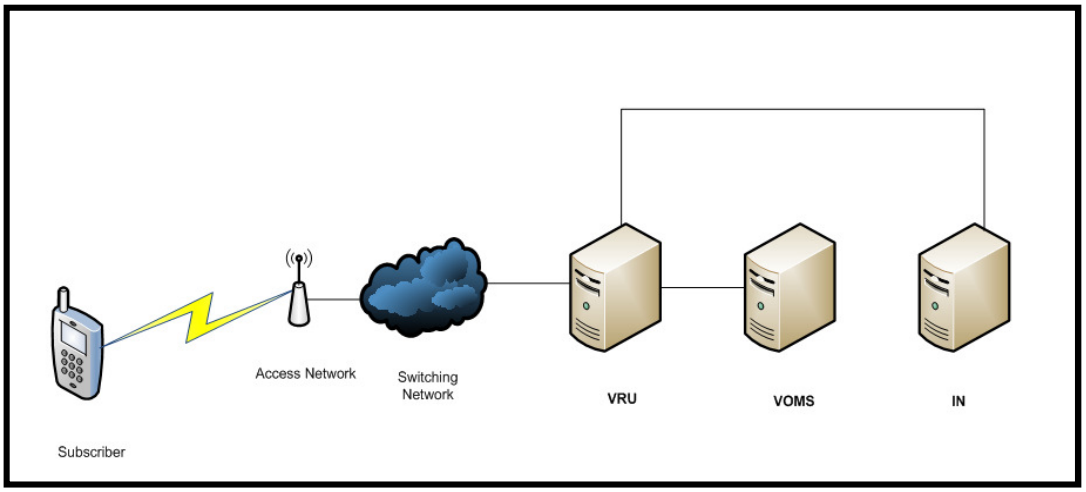

FIGURE 1.3: PrePaid layout for a mobile operator [6]

According to Gathercole [6] (see Figure 1.3), the flow was as follows: first VOMS would generate a personal identification number (PIN) with an associated airtime value stored in the VOMS. These PINs were distributed to retail shops where subscribers could purchase them. In order to recharge their accounts, subscribers would purchase a voucher and be provided a PIN. The subscriber then had to dial the Voice Response Unit (VRU) short code and the switching network would route the call to the VRU. The VRU would prompt the subscriber to enter the PIN. Upon entering the PIN, the VRU would send this request to VOMS. The VOMS would then authenticate the subscriber; and make sure that the voucher provided was valid and had not been used before. The value of the voucher was then returned to the VRU. The next leg of the transaction was for the VRU to compile this information into a file and place it in a folder on the system where it would be collected and by means of a file transfer sent to the IN. The IN would receive this file and the subscriber's account would be recharged accordingly [6].

This solution was kept in place for some years. Operationally it was an extremely busy system to support, and there were many other problems with such transactions. One of the problems was that communication failures between the systems occurred which would leave the recharges in pending states. The only solution to such problems was a great amount of manual intervention to eventually process the required recharges.

The main reason why the this initial solution (as described in Figure 1.3) was decided on, was that the VOMS could not communicate directly to the IN. The next evolutionary phase came about when VOMS had the capability to establish a connection with the IN directly. This process is represented in Figure 1.4.

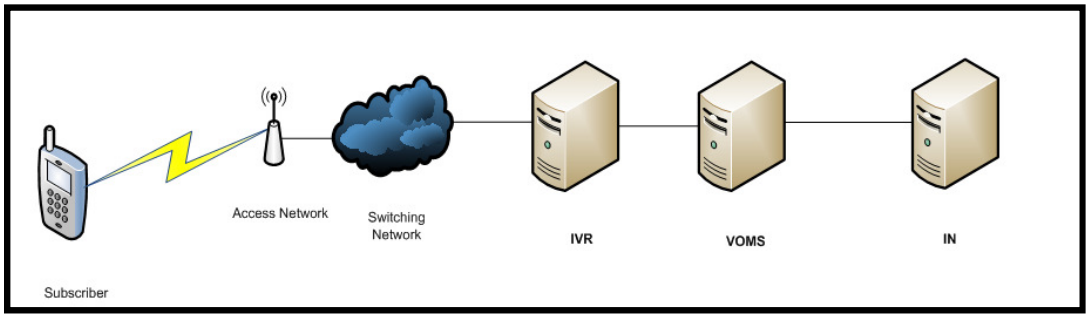

FIGURE 1.4: Subsequent architectural changes in how recharges were processed [6]

Figure 1.4 provides a depiction of how Gathercole [6] viewed the change of the VRU to the new Interactive Voice Response Unit (IVR). According to these architectural changes, the VOMS now had the technical capability to communicate with the IN directly [6].

This new VOMS architecture made use of good, high availability hardware, with a good uptime and the vendor guaranteed a downtime of no more than six minutes per year on the hardware. While good hardware alone would not provide a stable service, it would contribute only partially to the service uptime. Other factors that worked against the application service uptime were operator error, software bugs, network failures, and operating system upgrades, which would also include failovers from the primary sites to secondary sites. Thus, the overall uptime was a holistic effort of various factors that would determine the application service availability. A better architecture would be required to mitigate those factors, and to provide an application service availability exceeding five 9's.

1.3 THE PROBLEM STATEMENT AND RESEARCH QUESTIONS

1.3.1 Problem statement

The problem that was identified before the inception of this study was the shortfalls of a specific VOMS system. The focus of the study thus was placed on improving the uptime of an existing VOMS service. With the existing service, problems might be encountered when failures occurred due to software deployments, system upgrades and accidental user mistakes. The consequences were unnecessary downtime, which could have been avoided. An improvement in the design of VOMS architecture was required so that expensive downtime periods could be avoided.

According to Boohene and Agyapong [7], any mobile operator's brand reputation was important to maintain, and could not be put at stake by faulty or delayed service delivery. If a mobile operator was unable to provide quality service to its subscriber base, the consequences could have a financial impact. A direct relationship exists between customer loyalty and service offering. In the mobile operators' market, which had become extremely competitive in recent years, the quality of a mobile operator network was crucial to its continued business [7].

1.3.2 Research questions

The overall question that came to mind and guided this study, was: How does a mobile operator's PrePaid system need to evolve to meet a changing customer market?

To address the problem that was stated, the following secondary research questions were put forward and had to be answered:

1. *How could VOMS be described and contextualised as a theoretical framework of the study?*

2. *Could VOMS be designed to have a near 100% application service availability during a failure condition?*

3. *If it were possible to achieve a near 100% application service availability, would it be economically feasible to build such a new architecture?*

The research was conducted and centred on these three research questions. The results of this research, it is hoped, will serve as groundwork for assembling guidelines and making recommendations with a view to make a contribution to the effectiveness of the telecommunications industry.

1.4 THE GOAL, PURPOSE AND OBJECTIVES OF THE RESEARCH

1.4.1 Overall goal of the study

The overall goal of the study was to evaluate how a specific mobile operator implemented its VOMS installation and to determine if there were better methods to do this in order to improve its availability.

1.4.2 Purpose of the study

The purpose of the study was to improve the overall design for a new VOMS architecture that would provide a higher service application uptime than the current VOMS system, along with determining the feasibility of constructing a new VOMS architecture.

1.4.3 Objectives of the study

To accomplish the aim, the following objectives had to be attained:

- To describe and contextualise the current VOMS in a changing service market on the basis of a literature study with a view to compiling a theoretical framework within which to conduct the study.
  This objective addressed research question 1.

- To evaluate high availability concepts and compare these with the way in which a specific mobile operator had implemented its VOMS and improved its architecture.
  This objective addressed research question 2.

- To determine if it would be economically feasibility to construct such a newly proposed VOMS Architecture.
- *This objective addressed research question 3.*

1.5 DEMARCATION AND SCOPE OF THE FIELD OF STUDY

The scope of the project was limited to telecommunications, specifically, Core Network Technologies, with a focus on the PrePaid system and systems that constitute its composition, which is the VOMS within IN.

The study was aimed at VOMS architecture and identifying and proposing methods to improve its service availability and to achieve higher service availability as compared to an existing VOMS. VOMS in this context specifically implies the generation of vouchers and their verification and redemption. If VOMS were to be unavailable, subscribers would not be able to redeem vouchers to load their accounts with airtime or other value-added services (VAS). Any remaining airtime available on subscribers' IN accounts, once depleted, would not be able to recharge, leaving the subscriber base effectively unable to use their network and thus severely affecting a mobile operator's reputation. Such a situation affects the revenue of the mobile operator, as some mobile operators use VOMS for both recharging and charging (billing). The recharging typically is monetary voucher redemption, while the charging acted as a billing platform or online charging system. Consequently, if VOMS became unavailable, certain services would not be billed.

This would then be a violation of the service level agreement between a mobile operator and their subscriber base. Gillwald *et al.* [8] further adds that for any mobile operator in a competitive market, brand reputation is important to maintain. To be able to do this, it is of vital importance to provide a service that will not be disrupted. With evolving technologies, such a reality is feasible and possible [8].

The author has more than ten years' telecommunications experience and worked for various mobile operators, including Vodafone UK, O2 UK, Nortel Networks, Alcatel-Lucent and for various deployments in the United States based operators, including Verizon and Sprint. The author has been involved with PrePaid operational support for a mobile operator in South Africa for six years and held a senior position in his division. He

possesses many vendor hardware and software skill sets, with specific specialities which include Cisco, HP Non Stop Kernel, Oracle and MySQL databases, as well as Solution Architecture Design.

All other network elements within the Core Network had been excluded and were beyond the scope of this study.

1.6 THE ASSESSMENT AND IMPORTANCE OF THE STUDY

The significance of this study is to be found in the solution to the stated problem that would be to the benefit of subscribers of mobile operators should a VOMS, in the event of a failure, natural disaster or scheduled maintenance being unavailable.

The value of the research is that this solution will enable mobile operators to obtain an extremely high application service availability by means of the proposed new VOMS system.

The proposed model (VOMS) will enable mobile operators to have a VOMS service that would always be available. The subscribers and clients alike no longer will experience interruptions in the application service offering. The application service offering would be based on standard non-proprietary hardware. During scheduled maintenance, the engineering and operational support teams in the new system will be able to apply patch updates and general maintenance in a manner that would not disrupt services to subscribers and clients.

According to Khan *et al.* [9], the role of customers is changing within today's telecommunications environment. Mobile operators have to be more customer focused, and this strategy will bring them a competitive advantage. This in turn might very well prove to be the key to their survival. A mobile operator has to focus on the perceived service quality as it has become important to uphold. Very important, too, are retaining existing and attracting new customers and this can only be accomplished by maintaining customer satisfaction [9].

1.7 RESEARCH DESIGN AND METHODS OF INVESTIGATION

The research design is the plan or blueprint for how the study will be conducted, and the research methods refer to the ways in which data will be collected.

1.7.1 Design of the study

The design of this study comprised various components, including a literature study, a laboratory study to emulate the theoretical behaviour of the systems to determine the actual outcomes, and a financial comparison between the current and new systems to determine the feasibility of the new design.

1.7.2 Methods of investigation

The methods employed during this study were:

- A literature review and analysis of the effects of a changing consumer market
- A literature review of engineering concepts
- Integration of engineering products to deliver the VOMS emulator in a laboratory
- Testing of a number of scenarios to prove the attainment (or not) of the objectives of the investigation.

1.7.2.1 *Literature study*

The reason for the literature survey was to become knowledgeable about the area, as well as to gain a sound background in order to theorise and contextualise the lack of a best method for implementing a VOMS system within a PrePaid environment for mobile operators.

1.7.2.2 *Laboratory emulations*

The purpose of the emulations was to determine the degree to which the objectives set out for this study had been achieved, and to confirm the results of the project.

A synopsis of the study is provided in Figure 1.5.

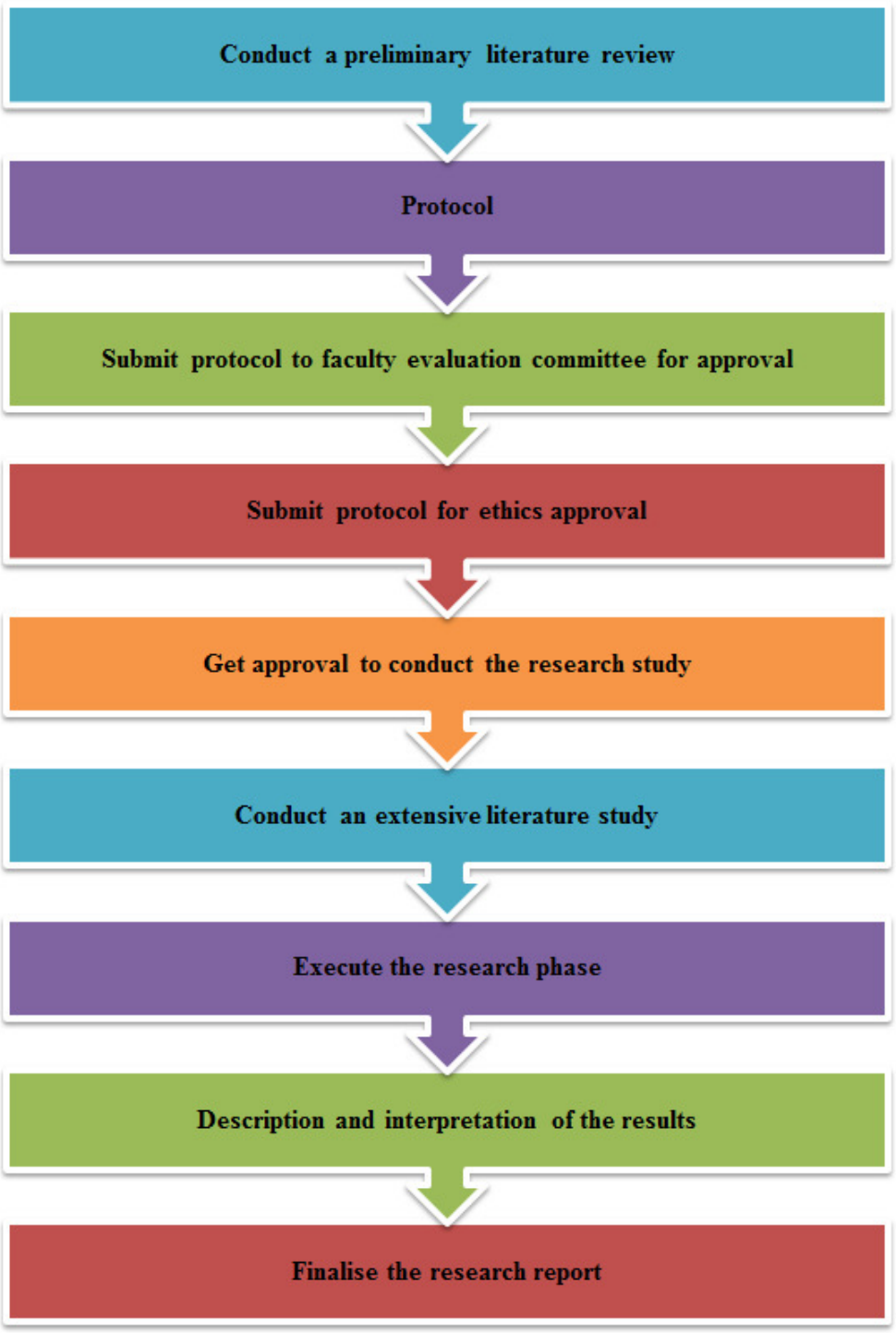

FIGURE 1.5: A synopsis of the study

1.8 STRUCTURE OF THE RESEARCH REPORT

The chapters of this research report have been structured as follows:

In this chapter, Chapter 1, **Introduction to the study**, the background to the study was presented and the challenges are explained that led to the problem that this study endeavoured to solve, including the research questions to which answers would be sought. The background to the problem is provided, as well as elucidations o VOMS and IN. The goal and aim of the study, as well as the objectives are identified. The methods of investigation and the value the results of the study might hold are succinctly discussed.

In Chapter 2, **VOMS factors rendering higher availability, and the impact of availability on the customer base,** VOMS factors bringing about higher availability are discussed and the impact of availability on the customer base receives attention.

Chapter 3, **Research design and methodology,** is devoted to a detailed description of the design guiding the study and the data gathering methods are elucidated.

In Chapter 4, **Description and interpretation of the results**, the results of the data collection will be reported, interpreted and discussed.

In Chapter 5, **Discussion of the results**, a full discussion of the results will be provided.

Chapter 6, G**uidelines, recommendations and conclusion,** will serve as a foundation for making a contribution to the effectiveness of operators' PrePaid offerings. This will be followed by the recommendations for further studies that could be undertaken. Finally, the limitations of the research will be mentioned.

1.9 CONCLUSION

Chapter one provided an introduction to VOMS, a short history of a VOMS and an overview of the research objectives, in terms of which the problem was investigated. Application service availability was a driving factor; architectures needed to be revisited to establish better methods of attaining higher application service availability. This went

hand in hand with customer expectation, in that service offerings need to be available at all times.

The next chapter, Chapter 2, entitled **VOMS factors rendering higher availability, and the impact of availability on the customer base**, contains a discussion of a study of relevant literature.